4.4 Hardware Design and Verification Assurance Processes

4.4.1 Boeing Design Philosophy

The design approach employed on the X-37 program is based on the rapid prototype philosophy and processes developed within the Boeing Phantom Works organization. The key elements of this design and design verification process are described below.

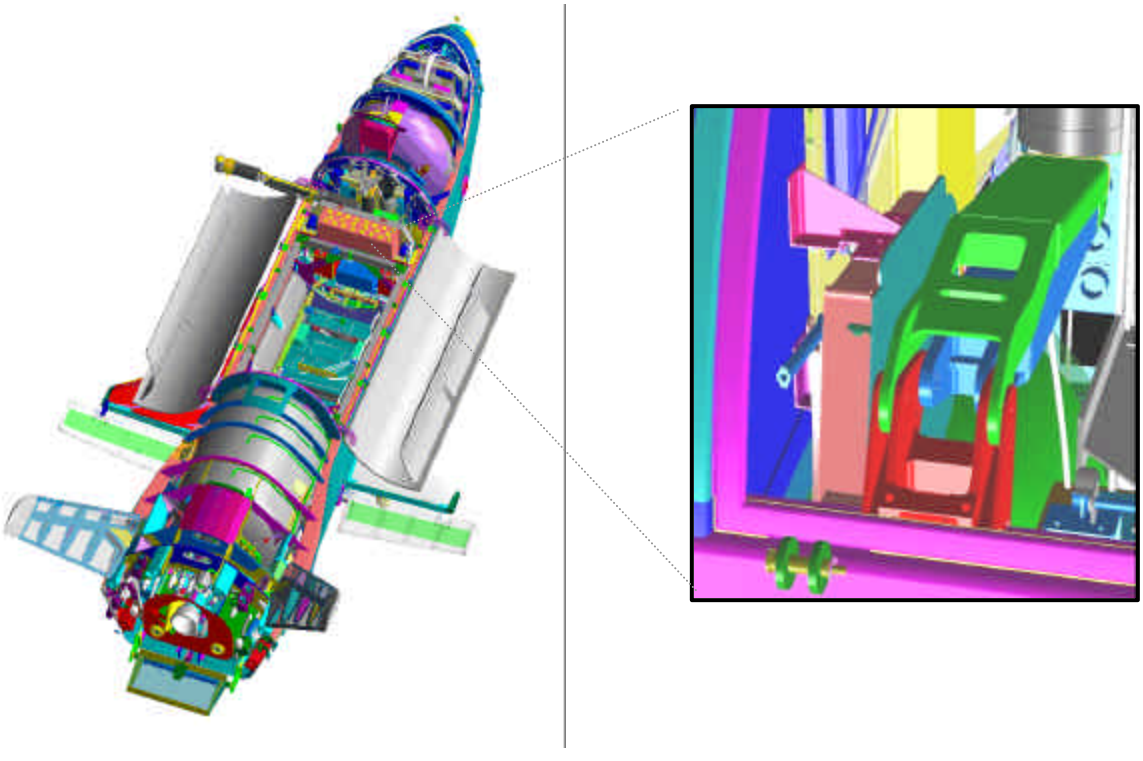
Co-Location of Personnel

Approximately 85 percent of the X-37 core project team (approximately 200 people) are collocated on one floor of the Seal Beach facility. This provides easy and convenient access among project team members and facilitates effective communication and problem resolution.

Digital MockUp (DMU)

The DMU is a computer-aided design tool that utilizes the CATIA software. The DMU, composed of the CATIA-generated solid model, parts list, and requirements, is an electronic digital mockup that facilitates the development, integration, and management of complex systems. The DMU facilitates real time, synchronized design integration across all disciplines and provides electronic configuration control and single source of design control. The DMU provides integration of over 2500 CATIA solid models with resolution down to the fastener level. Figure 4.10 is a typical representation of the utilization of the DMU.

Figure 4.10 Digital Mockup Unit (DMU): X-37 Vehicle Solid Model (with expanded view of mid-body battery pallet components)



Utilization of IPT's

IPT's corresponding to the eight major design elements of the X-37 project (listed below) have been formed.

- Flight Sciences
- Airframe/Structures
- Mechanical/Thermal/Propulsion
- Avionics, Power, and Software
- GN&C
- Vehicle Assembly
- System Test
- Shuttle Integration

Each team has a lead and the individual teams have primary responsibility for maintaining their own subsystem specifications, change control baselines, subcontractor requirements and statements-of-work (SOW's), material review boards, and risk mitigation activities. The SE&I IPT, as noted in the previous section of this report, has responsibility for assuring appropriate integration of the individual subsystem IPT activities. The X-37 Deputy for Systems Engineering leads the SE&I IPT with membership comprised of the various subsystem IPT leads, in addition to representation from Configuration Management, Risk Management, Requirements and Analysis, Systems Integration, and Reliability, Maintainability, and Supportability. Each individual IPT holds weekly technical interchange meetings (TIM). In addition, the IPT leads have their own weekly TIM.

Zone Managers

The X-37 vehicle has been divided into "zones" (i.e., fore, mid, aft) with each zone designated a zone captain. Their primary responsibility is to assure that all components within their zone are properly integrated within the Digital MockUp (DMU). The zone captains hold thrice weekly "fly-throughs" using the DMU.

Focused Tiger Teams

Tiger teams, smaller groups of engineers from across the IPT's, are formed to resolve specific multidisciplinary design problems when they arise.